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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

Applicants: Tomohiro KONDO et al.

Title: SURFACE FINISHING APPARATUS AND RELATED METHOD

Appl. No.: 10/772,429

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Examiner: Hadi SHAKERI

Art Unit: 3723

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Number:

BRIEF ON APPEAL

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Sir:

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REAL PARTY IN INTEREST

The real party in interest is Nissan Motor Co., Ltd.

RELATED APPEALS AND INTERFERENCES

There are no related appeals and interferences.

STATUS OF CLAIMS

The following constitutes a statement of the status of all the claims, wherein all claims currently rejected (claims 1, 3, 4, 6, 7, 9, 10, 26 and 27) are hereby appealed:

- | | |
|-----|-----------|
| 1. | Rejected |
| 2. | Cancelled |
| 3. | Rejected |
| 4. | Rejected |
| 5. | Cancelled |
| 6. | Rejected |
| 7. | Rejected |
| 8. | Cancelled |
| 9. | Rejected |
| 10. | Rejected |
| 11. | Withdrawn |
| 12. | Withdrawn |
| 13. | Withdrawn |
| 14. | Withdrawn |
| 15. | Withdrawn |
| 16. | Withdrawn |
| 17. | Withdrawn |
| 18. | Withdrawn |
| 19. | Withdrawn |
| 20. | Withdrawn |
| 21. | Cancelled |
| 22. | Cancelled |
| 23. | Withdrawn |
| 24. | Withdrawn |
| 25. | Cancelled |
| 26. | Rejected |

27. **Rejected**

STATUS OF AMENDMENTS

Although the March 26, 2008, Advisory Action does not state whether the March 05, 2008, amendments have been entered, it is believed that the March 05 amendments have been entered because the March 05 amendment merely cancels withdrawn claims 22 and 25. Thus, there are no claim amendments that have not been entered.

SUMMARY OF CLAIMED SUBJECT MATTER

The claims generally recite surface finishing apparatuses and surface finishing methods for surface finishing a target shaped periphery of a workpiece into a mid-concave profile. An example of a target shaped periphery of a workpiece includes a journal portion or a pin portion of a crankshaft for an internal combustion engine. (See Figs. 15A and 15B in view of Fig. 5.) These pieces are difficult to finish, especially in a high-output format (every internal combustion engine has a crankshaft, and even a medium size automobile company can be expected to need 3 million engines per year) because of their non-concentric locations on the crankshaft, their having shoulders on either side of the bearing piece, *etc.* Specific features of the claims on appeal shall now be discussed.¹

Claim 1: Claim 1 recites a surface finishing apparatus for surface finishing a target shaped periphery of a workpiece into a mid-concave profile. In the invention of claim 1, the surface finishing apparatus comprises:

- i) *referring to Fig. 1 and page 10 of the application, lines 7-26, a workpiece supporting mechanism (WS) for supporting the workpiece (W), which is depicted in the figures as being a crankshaft for an internal combustion engine (see Figs. 15A and 15B), having, with reference to Fig. 5, the target shaped periphery to be surface finished;*
- ii) *referring to Figs. 2 and 4, and page 12 of the application, lines 19-29, a surface finish tool (11) including a lapping film (11) adapted to be in abutting contact with the target shaped periphery of the workpiece (W);*
- iii) *referring to Figs. 2, and 4, and page 12 of the application, lines 19-29, a pressure applying mechanism (10) including a plurality of shoes (21A and 21B) disposed on a rear side of the lapping film (11) to be, referring to page 16 of the application, lines 21-30, operative to apply a pressure force to the lapping film (11) to cause the lapping film (11) to be held in pressured contact with the target shaped periphery of the workpiece (W);*
- iv) *referring to Figs. 1 and 8, and page 14 of the application, lines 2-14, a drive mechanism (40) for rotating the workpiece (W) about an axial direction during operation of the pressure applying mechanism to allow the surface finish tool (11) to surface finish the*

¹ Reference is made herein, with respect to the italicized language, by way of example only and not by way of limitation, to the following sections of the application.

target shaped periphery of the workpiece (W) into, referring to Fig. 5, the mid-concave profile, while, referring to Figs. 19A, 19B and 20, and page 8 of the application, lines 2-14, exhibiting a distribution pattern of the pressure force of the surface finish tool (11); and

(v) referring to Figs. 1 and 8, and page 14 of the application, lines 15-30, an oscillating mechanism (50) for oscillating at least one of the workpiece (W) and the lapping film (11) in the axial direction of the workpiece (W) in a given oscillation stroke such that a working position of the lapping film (11) is cyclically shifted, referring to page 22 of the application, at lines 8-19, in the given oscillation stroke with respect to the target shaped periphery of the workpiece (W) to allow the workpiece (W) to be surface finished in, referring to Fig. 5, the mid-concave profile,

wherein, referring to Figs. 2 and page 12 of the application, lines 19-29, the pressure applying mechanism (10) is adapted to operatively hold the plurality of shoes (21A and 21B) on the rear side of the lapping film (11) in, referring to Fig. 3, and page 16 of the application, lines 6-30, different contact areas in a partially overlapping relationship at a central region of the target shaped periphery of the workpiece (W) and in a non-overlapping relationship in both terminal regions (i.e., ends) of the target shaped periphery such that the plurality of shoes (21A and 21B) are held in opposing offset positions with offset displacement of each of the plurality of shoes set to be, with reference to page 18 of the application, lines 19-28, less than the given oscillation stroke provided by the oscillating mechanism to allow the central region of the target shaped periphery to be lapped at, with reference to page 20 of the application, lines 1-9, a greater rate than those at which other regions of the target shaped periphery are lapped, resulting in the target shaped periphery having a surface profile formed, with reference to pages 17-18 of the application, respectively, lines 29-18, in the mid-concave profile having a depth equal to or greater than 5 μm and equal to or less than 20 μm .

Claim 3: Claim 3 further defines the surface finishing apparatus according to claim 1, specifying that, referring to Fig. 3, and page 11 of the application, lines 9-22, the lapping film (11) includes a thin-walled base member (11a) having an entire surface provided with abrasive material with an abrasive surface (11b) of the thin-walled base member (11a), and, referring to Fig. 3 and page 12 of the application, lines 19-29, the plurality of shoes

(21A and 21B) allows the abrasive surface (11b) of the lapping film (11) to be held in contact with the target shaped periphery to be lapped.

Claim 4: Claim 4 further defines the surface finishing apparatus according to claim 3, specifying that, *referring to Fig. 2, and page 12 of the application, lines 19-29*, the pressure applying mechanism (10) includes a tool holder (28) that operatively holds the plurality of shoes (21A and 21B) on the rear side of the lapping film (11).

Claim 6: Claim 6 further defines the surface finishing apparatus according to claim 1, specifying that, *referring to page 17 of the application, lines 9-17*, the plurality of shoes (21A and 21 B) include an even number of shoes (21A and 21 B) with a same width and the even number of shoes (21A and 21 B) are, *referring to Fig. 3, and page 16 of the application, lines 6-20*, alternately offset at different sides with respect to a center of the target shaped periphery to be lapped.

Claim 7: Claim 7 further defines the surface finishing apparatus according to claim 1, specifying that, *referring to page 17 of the application, lines 18-21*, an amount of offset displacement between the plurality of shoes falls in a value ranging from 3 to 12 % of the given width of the target shaped periphery to be lapped.

Claim 9: Claim 9 further defines the surface finishing apparatus according to claim 3, specifying that, *referring to Fig. 3, and to pages 15-16 of the application, lines 29-05*, the workpiece (W) includes a crankshaft having a journal portion or a pin portion each having the target shaped periphery, on both ends of which fillet (Wf) portions are formed.

Claim 10: Claim 10 further defines the surface finishing apparatus according to claim 3, specifying that, *referring to Fig. 3, and page 11 of the application, lines 9-22*, the lapping film (11) includes the thin-walled base member (11a), the thin-walled base member being non-extensible and deformable.

Claim 26: Claim 26 recites a surface finishing apparatus for surface finishing a target shaped periphery of a workpiece into a mid-concave profile, comprising:

- i) referring to Fig. 1 and page 10 of the application, lines 7-26, a workpiece supporting means (WS) according to 35 U.S.C. §112, 6th paragraph, for supporting the workpiece (W), which is depicted in the figures as being a crankshaft for an internal combustion engine (see Figs. 15A and 15B), having, with reference to Fig. 5, the target shaped periphery to be surface finished;
 - ii) referring to Figs. 2 and 4, and page 12 of the application, lines 19-29, a surface finish tool (11) including a lapping film (11) adapted to be in abutting contact with the target shaped periphery of the workpiece (W);
 - iii) referring to Figs. 2, and 4, and page 12 of the application, lines 19-29, pressure applying means (10) according to 35 U.S.C. §112, 6th paragraph, for applying a pressure force to the lapping film (11) to cause the lapping film (11) to be, referring to page 16 of the application, lines 21-30, held in pressured contact with the target shaped periphery of the workpiece (W);
 - iv) referring to Figs. 1 and 8, and page 14 of the application, lines 2-14, a rotating means (40) according to 35 U.S.C. §112, 6th paragraph, for rotating the workpiece (W) about an axial direction during operation of the pressure applying means to allow the surface finish tool (11) to surface finish the target shaped periphery of the workpiece (W) into referring to Fig. 5, the mid-concave profile, while, referring to Figs. 19A, 19B and 20, and page 8 of the application, lines 2-14, exhibiting a distribution pattern of the pressure force of the surface finish tool (11); and
 - v) referring to Figs. 1 and 8, and page 14 of the application, lines 15-30, an oscillating means (50) according to 35 U.S.C. §112, 6th paragraph, for oscillating at least one of the workpiece (W) and the lapping film (11) in the axial direction of the workpiece (W) in a given oscillation stroke such that a working position of the lapping film (11) is, referring to page 22 of the application, at lines 8-19, cyclically shifted in the given oscillation stroke with respect to the target shaped periphery of the workpiece (W) to allow the workpiece (W) to be surface finished in, referring to Fig. 5, the mid-concave profile,
- wherein, referring to Fig. 2 and page 12 of the application, lines 19-29, the pressure applying means (10) is adapted to operatively apply pressure on a rear side of the lapping film (11) in different contact areas in a partially overlapping relationship at a central region of the target shaped periphery of the workpiece (W) and in a non-overlapping relationship in both

terminal regions (*i.e., ends*) of the target shaped periphery such that the portions of the pressure applying means disposed on the rear side of the lapping film are held in opposing offset positions with offset displacement of each of the portions of the pressure applying means (10) disposed on the rear side of the lapping film set to be, *with reference to page 18 of the application, lines 19-28*, less than the given oscillation stroke provided by the oscillating means to allow the central region of the target shaped periphery to be lapped at a, *with reference to page 20 of the application, lines 1-9*, greater rate than those at which other regions of the target shaped periphery are lapped, resulting in the target shaped periphery having a surface profile formed, *with reference to page 17-18 of the application, respectively lines 29-18*, in the mid-concave profile having a depth equal to or greater than 5 μm and equal to or less than 20 μm .

Claim 27: Claim 27 recites a method of surface finishing a target shaped periphery of a workpiece into a mid-concave profile, the method comprising:

- i) referring to Fig. 1 and page 10 of the application, lines 7-26, supporting the workpiece (W), *which is depicted in the figures as being a crankshaft for an internal combustion engine (see Figs. 15A and 15B)* having, *with reference to Fig. 5*, the target shaped periphery to be surface finished;
- ii) referring to Figs. 2 and 4, and page 12 of the application, lines, 19-29, holding a surface finish tool (11) including a lapping film (11) in abutting contact with the target shaped periphery of the workpiece (W);
- iii) referring to Figs. 2, and 4, and page 12 of the application, lines 19-29, disposing a plurality of shoes (21A and 21B) on a rear side of the lapping film (11) to apply a pressure force to the lapping film (11) to cause the lapping film (11) to be, *referring to page 16 of the application, lines 21-30*, held in pressured contact with the target shaped periphery of the workpiece (W);
- iv) referring to Figs. 1 and 8, and page 14 of the application, lines 2-14, rotating the workpiece (W) about an axial direction to allow the surface finish tool (11) to surface finish the target shaped periphery of the workpiece (W) into, *referring to Fig. 5*, the mid-concave profile, while, *referring to Figs. 19A, 19B and 20, and to page 8 of the application*,

lines 2-14, exhibiting a distribution pattern of the pressure force of the surface finish tool (11); and

v) *referring to Figs. 1 and 8, and page 14 of the application, lines 15-30, oscillating at least one of the workpiece (50) and the lapping film (11) in the axial direction of the workpiece (W) in a given oscillation stroke such that a working position of the lapping film (11) is, referring to page 22 of the application, at lines 8-19, cyclically shifted in the given oscillation stroke with respect to the target shaped periphery of the workpiece (W) to allow the workpiece (W) to be surface finished in, referring to Fig. 5, the mid-concave profile,*

wherein, referring to Fig. 2 and page 12 of the application, lines 19-29, the plurality of shoes (21A and 21B) are held on the rear side of the lapping film (11) in different contact areas in a partially overlapping relationship at a central region of the target shaped periphery of the workpiece (W) and in a non-overlapping relationship in both terminal regions (i.e., ends) of the target shaped periphery such that the plurality of shoes are held in opposing offset positions with offset displacement of each of the plurality of shoes set to be, with reference to page 18 of the application, lines 19-28, less than the given oscillation stroke to allow the central region of the target shaped periphery to be lapped at a, with reference to page 20 of the application, lines 1-9, greater rate than those at which other regions of the target shaped periphery are lapped, resulting in the target shaped periphery having a surface profile formed, with reference to page 17-18 of the application, respectively lines 29-18, in the mid-concave profile having a depth equal to or greater than 5 µm and equal to or less than 20 µm.

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

In the Final Office Action dated December 07, 2007, claims 1, 3, 4, 6, 7, 9, 10, 26 and 27 were finally rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Judge (U.S. Patent No. 4,682,444) in view of Japanese Publication No.: 10-217090 (JP '090). As the Advisory Action of March 26, 2008, provides no relief with respect to any rejection of any claim, it is presumed that the rejections of these claims still stand.

ARGUMENT

Each ground of rejection is traversed for the following reasons.

**THE GROUP OF CLAIMS 1, 3, 4, 6, 7, 9, 10 AND 26 REJECTED UNDER
35 U.S.C. §103(a)**

The prior art does not teach or suggest each feature of any of the independent claims, and even if the prior art did so teach/suggest each feature, the ordinary artisan, who is by definition not an innovator, would not have found it obvious to arrive at the invention of any claim now pending.

Appellants previously requested, in order to identify the location(s) of the apparent disconnect between Appellants' understanding of the present invention and the Examiners' understanding of the present invention, that if the claims were not allowed, the Examiner "fill in the chart below identifying where each element is taught in the cited references." (The claim chart below repeats the recitations of the end of claim 1, in a table format.) To date, the Examiner has never filled out this chart or otherwise indicated where each and every element may be found.

Appellants submit that the failure of the Examiner to fill out the below claim chart (a presumably relatively simple exercise, if all the claim elements were indeed present in the cited references) illustrates the fact that the prior art does not teach or suggest these features.

| <u>Claim recitation:</u> | <u>Located exactly here in this cited reference:</u> |
|--|--|
| an oscillating mechanism . . . to allow the workpiece to be surface finished in the mid-concave profile, | |
| [a component] adapted to operatively hold the plurality of shoes on the rear side of the lapping film in different contact areas in a partially overlapping relationship | |
| at a central region of the target shaped periphery of the workpiece | |
| and in non-overlapping relationship in both terminal regions of the target | |

| | |
|---|--|
| shaped periphery | |
| such that the plurality of shoes are held in opposing offset positions with offset displacement of each of the plurality of shoes | |
| set to be less than the given oscillation stroke provided by the oscillating mechanism. | |

Appellants submit that the above chart cannot be completed, thus evincing the fact that the cited references do not teach or suggest each element of claim 1.

* * * * *

As a patentably distinguishing feature, the apparatus claims recite the feature of a “pressure applying mechanism that is adapted to operatively hold [a] plurality of shoes” in the recited manner to permit the apparatus to lap a workpiece in the recited manner. (Claim 1, beginning of last paragraph, emphasis added.) Specifically, claim 1 recites that the pressure applying mechanism is adapted to hold the shoes in a partially overlapping relationship in certain areas and in a non-overlapping relationship in other areas such that the shoes are held in opposing offset positions.

For the purposes of this appeal, Appellants assert that the combination of Judge with JP '090 does not teach or suggest:

A. The apparatus as claimed where the pressure applying mechanism is adapted to hold the shoes such that an offset displacement of each of the plurality of shoes is set to be “less than a given oscillation stroke provided by [an] oscillating mechanism [of the apparatus],” (hereinafter, “feature A”), and

B. The apparatus as claimed where the pressure applying mechanism is adapted to hold the shoes such that the workpiece may be lapped to obtain a “target shaped periphery

having a surface profile formed in the mid-concave profile having a depth equal to or greater than 5 μm and equal to or less than 20 μm ,” (hereinafter, “feature B”).²

Neither Judge nor JP ’090, alone or in combination, result in an apparatus having either feature “A” or “B” of claim 1, and, as noted above, the Examiner has never pointed to where either of those references, teach these elements. Instead, the Examiner sweeps aside the missing recitations by asserting that “the intended use or desired finish of the workpiece does not further limit the apparatus.” (Final Office Action, page 2, numbered paragraph 2.) Appellants disagree for at least the reasons that follow.

I. Preliminary Matter No. 1 – Claim Recitations are Improperly Being Disregarded

As a preliminary matter, it is incorrect as a matter of law to assert that the missing recitations are a mere matter of “intended use,” *etc.*, as is asserted on page 2 of the Final Office Action. As noted above, the last paragraph of claim 1 makes use of the phrase “adapted to.” Specifically, claim 1 recites that the pressure applying mechanism is “adapted to” hold the shoes to obtain the elements recited in the claim.³

Appellants deliberately chose to use the phrase “adapted to” in the claims. Both the Court of Appeals for the Federal Circuit and the CCPA, which has/had exclusive appellate review over the grant and denial of patent claims, and the Board of Patent Appeals and Interferences within the PTO, have repeatedly held that functional limitations may be used to claim a structure capable of performing a recited function, and that functional limitations connote structure that must be taken into account in comparing a claim from to the prior art. For example, *In re Venezia*, which is specifically cited at MPEP §2173.05(g), held that functional language, such as “member adapted to be positioned,” connotes a structural

² These features are significant and result in improved crankshafts, etc., as is detailed in the specification (see, e.g., the references to the tests performed on the finished products).

³ *i.e.*, as noted above, claim 1 recites that the pressure applying mechanism is adapted to hold the shoes in a partially overlapping relationship in certain areas and in a non-overlapping relationship in other areas such that the shoes are held in opposing offset positions. Claim 1 recites that the pressure applying mechanism is adapted to hold the shoes such that an offset displacement of each of the plurality of shoes is set to be “less than a given oscillation stroke provided by [an] oscillating mechanism [of the apparatus],” to control lapping of the workpiece in a manner “resulting in the target shaped periphery having a surface profile formed in the mid-concave profile having a depth equal to or greater than 5 μm and equal to or less than 20 μm . ”

limitation that accordingly must be given patentable weight in evaluating a claim. (*In re Venezia*, 530 F.2d 956, 959, 189 USPQ 149, 151-52 (CCPA 1976).) A more recent case, *Pac-Tec v. Amerace Co.*, upheld the validity of a claim utilizing the phrase “adapted to,” followed by a recitation of function, on the grounds that functional language may not be disregarded in evaluating patentability in view of the prior art. (*Pac-Tec v. Amerace Co.*, 903 F.2d 796, 800-01, 14 USPQ2d 1871 (Fed. Cir. 1990).)

Appellants believe that very many Board of Patent Appeals and Interferences Decision cite *In re Venezia* in cases where claims at issue utilized functional language. One of the more recent Board decisions on point, *Ex Parte Vickie Miller and Terry Miller*, stated that the

various functional limitations in the claims (e.g., that the elongated member is “adapted to extend between an armrest assembly and a seat member” . . .) set forth a function which the apparatus must be structurally capable of performing (see, e.g., *In re Venezia*) and such a functional statement must be given full weight and may not be disregarded in evaluating the patentability of the claims.

(Emphasis added, citations omitted.) (*Ex Parte Vickie Miller and Terry Miller*, Appeal No. 97-0972, Application No. 08/399,571, 1997 WL 1883929.)

In sum, both the Federal Circuit and the Board of Patent Appeals and Interferences recognize that functional claim language connotes structural recitations which must be considered in evaluating the patentability of an invention in view of the prior art, and thus the direction of MPEP §2173.05(g) in this regard is correct, and the Examiner’s treatment of the recitations of claim 1 is not correct.

II. Preliminary Matter No. 2 – The Examiner Improperly Asserts, Without Foundation, Knowledge in the Art, Contrary to Case Law and the MPEP

As another preliminary matter, the Final Office Action is full of impermissible unsupported assertions where a missing feature from the prior art is “considered well within the knowledge of one of ordinary skill in the art,” “well within the knowledge of one of ordinary skill in the art,” or the like. Appellants identify no less than 4 instances where the

Examiner relies on such arguments, without any supporting evidence or rationale whatsoever, while in only one instance does the Examiner cite to evidence supporting his assertion of what was known in the art (the reference to the Philips Patent, on line 7 of page 5 of the Final Office Action).

In re Ahlert, cited in MPEP §2144.03(A), states that “[A]llegations concerning specific ‘knowledge’ of the prior art, which might be peculiar to a particular art should also be supported and the appellant similarly given the opportunity to make a challenge.” Along these lines, Appellants recognize that the MPEP permits, in very limited circumstances, reliance on “Common Knowledge in the Art,” but notes that the MPEP states clearly that “[w]hile ‘official notice’ may be relied on, these circumstances should be rare when an application is under final rejection . . . [o]fficial notice unsupported by documentary evidence should only be taken by the examiner where the facts asserted to be well-known, or to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known.” (MPEP §2144.03(A)).

Citing *In re Ahlert*, MPEP §2144.03(A) states that the notice of facts beyond the record which may be taken by the examiner must be “capable of such instant and unquestionable demonstration as to defy dispute.” (*In re Ahlert*, 424 F.2d 1088, 1091, 165 USPQ 418, 420 (CCPA 1970).) *In re Zurko*, also cited in MPEP §2144.03(A), states that

the Board cannot simply reach conclusions based on its own understanding or experience-or on its assessment of what would be basic knowledge or common sense. Rather, the Board must point to some concrete evidence in the record in support of these findings. To hold otherwise would render the process of appellate review for substantial evidence on the record a meaningless exercise.

(258 F.3d 1379, 1389, 59 USPQ2d 1693, 1697 (Fed. Cir. 2001).) Here, the assertions of fact about the knowledge in the art regarding the missing features of claim 1 are not “capable of such instant and unquestionable demonstration as to defy dispute,” and the Examiner has not pointed to any “concrete evidence in the record in support of the findings.” Just the opposite. Appellants have frequently disputed these assertions and explained why such was not common knowledge, and repeatedly requested that the Examiner “cite a reference and exactly

identify where such a reference teaches the alleged common knowledge," but never has the Examiner responded.

In summary, the rejections are predicated upon frequent unfounded allegations of what was common knowledge in the art, in contrast to *In re Zurko*, *In re Ahlert*, and the guidelines in the MPEP regarding reliance on common knowledge after a final rejection.

III. The Non-Obviousness of Feature “A”

Claim 1 recites, as a patentably distinguishing feature, that the pressure applying mechanism

is adapted to operatively hold the plurality of shoes on the rear side of thelapping film in different contact areas in a partially overlapping relationship at a central region of the target shaped periphery of the workpiece and in non-overlapping relationship in both terminal regions of the target shaped periphery such that the plurality of shoes are held in opposing offset positions with offset displacement of each of the plurality of shoes set to be less than the given oscillation stroke provided by the oscillating mechanism.

(Emphasis added.)

Neither Judge nor JP '090 teach or suggest the feature of shoes held as recited. Specifically, the shoes of JP '090 are not held in opposing offset positions such that their respective offset displacements are set to be less than the given oscillating stroke provided by the oscillating mechanism. Based on the record to date, JP '090 teaches nothing about the relative dimensions of the shoes with respect to the axial movement of the workpiece (base on the translated abstract and the figures, JP '090 does not indicate that the drawings may be scaled to reverse-engineer this feature, and Appellants submit that even if the drawings were to be scaled, it is impossible to accurately extract such a teaching from JP '090). Judge does not remedy the deficiencies of JP '090.

In the “Response to Arguments” section of the last Office Action, the Examiner asserts that

the argument that the claim limitations are not met regarding the offset displacement and the stroke oscillation, is not valid since the combined references meet this *either* as explicitly disclosed by the drawings in JP '090 or adapted [sic] to overlap to polish the central region more than the peripheral region (well within the knowledge of one of ordinary skill in the art)

(Office Action, page 3, lines 18-22, emphasis added.) Appellants first note that by stating “either as explicitly disclosed . . . or,” the Examiner demonstrates the inability to identify where the missing recitations are actually taught in the cited references. Second, Appellants respectfully submit that this is merely a conclusory assertion that is substantiated by nothing on the record to evince or even suggest this assertion.

The Examiner asserts that the features regarding the offset position vis-à-vis the oscillation stroke (feature “A”) “does not and cannot patentability limit the apparatus over another apparatus having the same ability, since the combined references is [sic] adapted to or capable of setting such a value.” (Final Office Action, page 4, lines 3-5.) First, there is no evidence at all to substantiate the allegation that the cited references have “the same ability” as the device as claimed. Second, the mere fact that the ordinary artisan has the capability to modify a prior art device to obtain a new device according to a patent claim does not render the patent claim obvious. Indeed, if such was the case, then most, if not all, patent claims would be obvious, as almost all claims are based on the prior work of others. Moreover, under the enablement requirement of 35 U.S.C. §112, first paragraph, the skilled artisan would necessarily have to be able to modify the prior art to arrive at the present invention. It is submitted that the assertions presented in the Office Action regarding the capabilities of the ordinary artisan, even if taken as true, do not render the claims obvious. The test for obviousness is whether the ordinary artisan would have been vested with knowledge

sufficient to modify that device without instruction from the innovator, not whether the ordinary artisan was simply capable of modifying the prior art.⁴

* * * * *

In the Final Office Action (and the Office Action precedent), the Examiner emphatically states that he is not relying on “design choice” to disposition the missing recitation regarding the offset (*i.e.*, feature “A”). (Office Action, page 4, line 1.) If it would *not* have been a matter of design choice to modify the two cited references to have feature “A,” which is not present in the art, how then would it have been obvious to arrive at the present invention? The Examiner has not explained this. It is submitted that he cannot explain this. Instead, the Examiner presents the circular argument that anything that is “capable of or can be adapted to” meet the requirements of feature “A” meets the apparatus claims. (Office Action, page 4, lines 12-14, emphasis added.) This is yet another example of the Examiner relying on the mere allegation that because the prior art may be modified, the claims are obvious, which is not the standard for determining whether a claim is obvious.

* * * * *

The Final Office Action asserts that “Fig. 1 in JP ’090 appears to disclose a larger oscillation than the offset displacement for the different size shoes and Fig. 2 [of JP ’090] also appear [sic] to disclose such arrangements” (Office Action, page 4, lines 6-8, emphasis added.) This is not so. To the extent that one may rely on the Figs. of JP ’090 as teaching relative dimensions, as is attempted to be done in the Final Office Action, the figures of JP ’090 unequivocally teach that the offset displacement of the depicted shoes is *greater* than the oscillation stroke. It must be, because, as shown in Fig. 2, if the workpiece 1 is oscillated with the larger oscillation stroke, thelapping paper 3 instantly rides on the curved surfaces of the workpiece 1 which flair upwards and downwards into the shoulders, and then, very shortly after, into the shoulders of the workpiece 1, because the offset displacement of the lap shoes 2 are of a relatively large dimension as compared to the distance available for an oscillation stroke, as can easily be seen. Moreover, the structure of JP ’090 is governed by a

⁴ Appellants, of course, recognize that a situation where the prior art cannot be modified to arrive at a claimed invention is a situation indicative of non-obviousness.

design constraint that prevents the workpiece 1 from having a larger stroke (*i.e.*, assuming *arguendo* that the curved surfaces and the shoulders were not in the way) to avoid overlapping, which would remove the recesses 6 (see Fig. 4 of JP '090). That is, the distance of the oscillation stroke must be purposely limited in JP '090, based on a review of the figures. In this regard, the objective of JP '090 is to prevent the workpiece 1 from being over lapped to ensure the presence of recesses 6 in the final product. Accordingly, it is no accident that JP '090 teaches the structures depicted in Figs. 1 and 2 in which the lap shoes 2 have lapping regions that are set along the axis "X" and are set in a manner such that the offset displacement of the depicted shoes is greater than the oscillation stroke, in contrast to feature "A."

* * * * *

The Examiner alleges that the ordinary artisan would have been motivated to modify the invention of Judge with the arrangement as taught by JP '090 to arrive at the invention of claim 1 "to prevent local excessive shaving," pointing to the Abstract of JP '090. (Final Office Action, page 4, lines 19-20.) Appellants disagree that such motivation is found in the teachings of JP '090, at least insofar as there is any motivation to arrive at the features of claim 1 regarding the offset displacement of the shoes.

True, in the "problem to be solved" section of the abstract of JP '090, JP '090 states that the problem to be solved is to "prevent local excessive shaving," just as is quoted in the Office Action. However, the next words are "and improve straightness of a finishing surface." (Emphasis added.) That is, the preventing of "local excessive shaving" is directed towards the ultimate goal of obtaining an improved straightness the finishing surface. Thus, according to the disclosure relied on in the Final Office Action, JP '090 teaches away from the present invention, as will now be explained (and expanded upon below).

In *In re Geisler*, cited in MPEP §2144.05(III), entitled Rebuttal Of *Prima Facie* Case Of Obviousness, the Federal Circuit reaffirmed CCPA case law that "a *prima facie* case of obviousness can be rebutted if the applicant . . . can show 'that the art in any material respect taught away' from the claimed invention." (116 F.3d 1465, 1469, 43 USPQ2d 1362 (Fed.

Cir. 1997).) Citing *In re Grasselli*,⁵ MPEP §2145(X)(2), states that it “is improper to combine references where the references teach away from their combination.” (Emphasis added.)

As will be detailed more fully below, JP '090 teaches away from the claimed feature of producing a mid-concave profile by teaching that it seeks to “improve *straightness* of a finishing surface.” (Problem to be solved section, emphasis added – see Evidence Appendix.) Thus, far from imparting a mid-concave profile onto the workpiece, JP '090 seeks to eliminate such a profile, and thus teaches away from a device for producing a mid-concave shape.

Accordingly, to the extent that the teaching of preventing local excessive shaving is a teaching that would have been relied on in by the ordinary artisan, that teaching is a teaching that teaches away from the present invention, and thus to the extent that a *prima facie* case of obviousness might have been established, such case is hereby rebutted in view of case law.

* * * * *

On page 6 of the Final Office Action, lines 8-9, the Examiner asserts that modification to the prior art “would only require routine experimentations with predictable results. Appellants again point to *In re Antonie*,⁶ the case cited in MPEP §2144.05 II(B), regarding optimization.⁷ Referring to *In re Antonie*, the MPEP states that a

particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation. *In re Antonie* (citations omitted). (The claimed wastewater treatment device had a tank volume to contractor area of 0.12 gal./sq. ft. The prior art did not recognize that treatment capacity is a function of the tank volume to contractor ratio, and therefore the parameter optimized was not recognized in the art to be a result-effective variable.)

⁵ 713 F.2d 731, 743, 218 USPQ 769, 779 (Fed. Cir. 1983).

⁶ 559 F.2d 618, 195 USPQ 6 (CCPA 1977).

⁷ This is the third time that Appellants have raised this issue. As of this writing, the Examiner has never commented on this issue, let alone explained why the facts of this case comport with *In re Antonie* and/or why *In re Antonie*, which is cited in the MPEP, is not good law / not applicable.

(Emphasis added.) As in *In re Antonie*, the prior art does not recognize that the recited claim features are result-effective variables, and, as is the case with the other missing elements, no evidence or rationale has been proffered to the contrary.

* * * * *

In summary, a *prima facie* case of obviousness with respect to feature “A” has not been established for at least the reasons just detailed, and claim 1 is allowable.

IV. The Non-Obviousness of Feature “B”

Feature “B” presents another patentably distinguishing feature. Feature “B” is the feature that the pressure applying mechanism

is adapted to operatively hold the plurality of shoes . . . to allow the central region of the target shaped periphery to be lapped at a greater rate than those at which other regions of the target shaped periphery are lapped, resulting in the target shaped periphery having a surface profile formed in the mid-concave profile having a depth equal to or greater than 5 μm and equal to or less than 20 μm .

(Claim 1, emphasis added.)

Neither Judge nor JP ’090 teach or suggest the feature of a lapping apparatus adapted to hold shoes to produce a target shaped periphery having a surface profile formed in the mid-concave profile having a depth equal to or greater than 5 μm and equal to or less than 20 μm . As noted above, the fact that claim 1 claims that the apparatus is “adapted to” produce the profile as claimed means that, as a matter of law, claim 1 claims the structure to do so, and, accordingly, it is not correct to dismiss this recitation based on the simple assertion that “the intended use or desired finish of the workpiece does not further limit the apparatus.” (Final Office Action, page 2, numbered paragraph 2.)

The Examiner asserts that it would have been obvious to modify Judge in view of JP ’090 to achieve an apparatus capable of meeting the above-quoted recitation of claim 1, despite the fact that such a modification to Judge would have rendered Judge unsatisfactory

for its intended purpose, a result that is forbidden. In this regard, citing *In re Gordon*,⁸ MPEP §2143.01(V) states that “the proposed modification cannot render the prior art unsatisfactory for its intended purpose.” The teachings of Judge are directed towards producing a barrel shaped cam or journal bearing. That is, the purpose of Judge is to produce a workpiece with a *convex* profile, not a mid-*concave* profile, as is claimed in claim 1. By modifying Judge as proffered in the Office Action to obtain a mid-concave finish of the work surface, Judge will not be able to produce a “barrel” shaped cam. Thus, by modifying Judge as proffered in the Office Action, Judge is rendered unsatisfactory for its intended purpose, and thus the modification proffered in the Final Office Action violates *In re Gordon*’s prohibition against rendering a reference unsatisfactory for its intended purpose.

* * * * *

In *In re Geisler*, cited in MPEP §2144.05(III), entitled Rebuttal Of *Prima Facie* Case Of Obviousness, the Federal Circuit reaffirmed CCPA case law that “a *prima facie* case of obviousness can be rebutted if the applicant . . . can show ‘that the art in any material respect taught away’ from the claimed invention.” (116 F.3d 1465, 1469, 43 USPQ2d 1362 (Fed. Cir. 1997).) Citing *In re Grasselli*,⁹ MPEP §2145(X)(2), states that it “is improper to combine references where the references teach away from their combination.” (Emphasis added.)

As previously noted, neither cited reference teaches or suggests the claimed features as they relate to producing a mid-concave profile. In fact, JP ’090 teaches away from this feature, because JP ’090 teaches that it seeks to “improve *straightness* of a finishing surface.” (Problem to be solved section, emphasis added – see Evidence Appendix.) Thus, far from imparting a mid-concave profile onto the workpiece, JP ’090 seeks to eliminate such a profile, and thus teaches away from a device for producing a mid-concave shape, because purposely producing a curved shape (in this instance, concave shape) is the antithesis of “improving straightness.” In the same vein, “improving straightness” is also the antithesis of producing a barrel shape. Along these lines, Judge teaches that its assembly results in a

⁸ 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984).

⁹ 713 F.2d 731, 743, 218 USPQ 769, 779 (Fed. Cir. 1983).

“barrel shaped” cam. Accordingly, both JP ‘090 and Judge in fact teach away from the invention as claimed, and JP ‘090 clearly directs its teachings towards the elimination of either a convex shape or a concave shape.

The Examiner attempts to counter this solid argument by asserting, in a total conclusory manner, that the argument is “invalid,” and that “pointing out to [sic] an exemplary embodiment in a reference to indicate that the reference is teaching away from the claimed invention is not persuasive.” (Final Office Action, page 5, lines 19-21.) First, the argument is completely valid and predicated upon case law – case law cited in the MPEP. Second, Appellants do not point to an exemplary embodiment, they point to the entire problem to be solved by the teachings of JP ‘090. The teachings of JP ‘090 are directed towards solving a problem – insufficient straightness of lapped components. Appellants are not relying on one embodiment *vs.* another embodiment, or even an “exemplary embodiment” to support their argument that JP ‘090 teaches away from the present invention. Instead, Appellants are relying on a teaching of JP ‘090 that goes to the very heart of the teachings in the references. The entire purpose of JP ‘090 is to “improve straightness.” *How can a reference that is apparently totally directed towards “improving straightness” not be considered to teach away from producing a surface that is curved (i.e., a non-straight surface - a concave surface)?* Appellants’ reasoning is consistent with the case law and the MPEP, and, in this regard, the common sense standard articulated in *KSR*. The ordinary artisan, who is by definition not an innovator, seeking to purposely obtain a non-straight surface, would not have sought out JP ‘090, which teaches a device to improve straightness! The ordinary artisan seeking a non-straight surface would decidedly not have sought out a reference that teaches improving straightness. Obtaining improved straightness is not a mere exemplary embodiment of JP ‘090 – it is the embodiment of JP ‘090, and that embodiment teaches away from the present invention.¹⁰

Accordingly, to the extent that *a prima facie* case of obviousness might have been established, such case is hereby rebutted in view of case law.

* * * * *

MPEP § 2143.02 is entitled a “Reasonable Expectation of Success Is Required.” MPEP §2143.02(I), citing *In re Merck & Co., Inc.*,¹¹ states that the “prior art can be modified or combined to reject claims as *prima facie* obviousness as long as there is a reasonable expectation of success.” (Emphasis added.) MPEP §2143.02(II), citing *In re Rinehart*,¹² states that while obviousness “does not require absolute predictability . . . at least some degree of predictability is required.” There is no evidence in the references, and certainly none identified by the Examiner, that one of ordinary skill in the art would have had a reasonable expectation of success in achieving Appellants’ invention by modifying Judge in accordance with JP ’090.

Specifically, regarding feature “B,” claim 1 recites that the claimed apparatus is adapted to operatively hold the plurality of shoes . . . to allow the central region of the target shaped periphery to be lapped at a greater rate than those at which other regions of the target shaped periphery are lapped, resulting in the target shaped periphery having a surface profile formed in the mid-concave profile having a depth equal to or greater than 5 µm and equal to or less than 20 µm. These values are exceedingly small, 75 µm being about the thickness of a sheet of paper. That is, the apparatus of claim 1 is adapted to produce a mid-concave profile that has a depth that is kept within a range (5 µm - 20 µm) that is about 1/5th of the thickness of a sheet of paper! In this context, it is respectfully submitted that the ordinary artisan would not have had a reasonable expectation of success in modifying Judge to arrive at this feature of claim 1. Indeed, the very reference relied on by the Examiner, JP ’090, demonstrates that this art is not predictable, as JP ’090 is directed towards “improving straightness,” as the “Problem to be Solved” section of JP ’090 explicitly states. No evidence has been proffered by the Examiner to rebut Appellants’ argument that the ordinary artisan would not have had a reasonable expectation of successfully modifying Judge to arrive at the invention as claimed, and, in fact, the evidence of record provided by the Examiner (JP ’090) indicates a general difficulty in this art to control resulting dimensions of lapped surfaces.

¹⁰ Another way to look at this is to recognize that the Examiner has pointed to no embodiment of JP ’090 that is used to obtain a non-straight surface.

¹¹ 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986)

¹² 531 F.2d 1048, 189 USPQ 143 (CCPA 1976).

Thus, one of ordinary skill in the art would not have seen the combination of the references as producing a successful finishing device as claimed. Because there existed a lack of a reasonable expectation of success in achieving Appellants' invention of claim 1, a *prima facie* case of obviousness has therefore not been established.

* * * * *

In summary, a *prima facie* case of obviousness with respect to feature "B" has not been established for at least the reasons just detailed, and claim 1 is allowable.

V. Claim 26

Claim 26 is allowable for at least the reasons that render claim 1 allowable, as detailed above.

VI. Claims 3, 4, 6, 7, 9 and 10: The claims that ultimately depend from claim 1 are allowable for at least the reasons that render claim 1 allowable, as detailed above.

THE GROUP OF CLAIM 27 REJECTED UNDER 35 U.S.C. §103(a)

Claim 27 is a method claim that is allowable for at least the reasons that render claim 1 allowable, as detailed above. Moreover, because claim 27 is a method claim, the Examiner's arguments pertaining to apparatus claim 1 regarding what allegedly does not need to be considered as a limitation (what the apparatus is or is not adapted to do) are moot. Accordingly, to the extent that those arguments may be accepted, those arguments do not apply to method claim 27. Put another way, assuming *arguendo* that the teachings of Judge are capable of modification to obtain an apparatus as claimed in claim 1, and thus features "A" and "B" may be disregarded, those features cannot be disregarded when evaluating the patentability of a method claim.

Conclusion

Appellants respectfully request that all rejections be reversed for at least the reasons set forth above.

Date

July 07, 2005

Respectfully submitted,

By

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CLAIMS APPENDIX

1. A surface finishing apparatus for surface finishing a target shaped periphery of a workpiece into a mid-concave profile, comprising:

a workpiece supporting mechanism for supporting the workpiece having the target shaped periphery to be surface finished;

a surface finish tool including a lapping film adapted to be in abutting contact with the target shaped periphery of the workpiece;

a pressure applying mechanism including a plurality of shoes disposed on a rear side of the lapping film to be operative to apply a pressure force to the lapping film to cause the lapping film to be held in pressured contact with the target shaped periphery of the workpiece;

a drive mechanism for rotating the workpiece about an axial direction during operation of the pressure applying mechanism to allow the surface finish tool to surface finish the target shaped periphery of the workpiece into the mid-concave profile, while exhibiting a distribution pattern of the pressure force of the surface finish tool; and

an oscillating mechanism for oscillating at least one of the workpiece and the lapping film in the axial direction of the workpiece in a given oscillation stroke such that a working position of the lapping film is cyclically shifted in the given oscillation stroke with respect to the target shaped periphery of the workpiece to allow the workpiece to be surface finished in the mid-concave profile,

wherein the pressure applying mechanism is adapted to operatively hold the plurality of shoes on the rear side of the lapping film in different contact areas in a partially overlapping relationship at a central region of the target shaped periphery of the workpiece and in non-overlapping relationship in both terminal regions of the target shaped periphery such that the plurality of shoes are held in opposing offset positions with offset displacement of each of the plurality of shoes set to be less than the given oscillation stroke provided by the oscillating mechanism to allow the central region of the target shaped periphery to be lapped at a greater rate than those at which other regions of the target shaped periphery are lapped, resulting in the target shaped periphery having a surface profile formed in the mid-concave profile having a depth equal to or greater than 5 μm and equal to or less than 20 μm .

3. The surface finishing apparatus according to claim 1, wherein:
the lapping film includes a thin-walled base member having an entire surface provided
with abrasive material with an abrasive surface of the thin-walled base member; and
the plurality of shoes allows the abrasive surface of the lapping film to be held in
contact with the target shaped periphery to be lapped.

4. The surface finishing apparatus according to claim 3, wherein the pressure
applying mechanism includes a tool holder that operatively holds the plurality of shoes on the
rear side of the lapping film.

6. The surface finishing apparatus according to claim 1, wherein the plurality of
shoes include an even number of shoes with a same width and the even number of shoes are
alternately offset at different sides with respect to a center of the target shaped periphery to be
lapped.

7. The surface finishing apparatus according to claim 1, wherein an amount of
offset displacement between the plurality of shoes falls in a value

9. The surface finishing apparatus according to claim 3, wherein the workpiece
includes a crankshaft having a journal portion or a pin portion each having the target shaped
periphery, on both ends of which fillet portions are formed.

10. The surface finishing apparatus according to claim 3, wherein the lapping film
includes the thin-walled base member, the thin-walled base member being non-extensible and
deformable.

26. A surface finishing apparatus for surface finishing a target shaped periphery of
a workpiece into a mid-concave profile, comprising:

workpiece supporting means for supporting the workpiece having the target shaped
periphery to be surface finished;

a surface finish tool including a lapping film adapted to be in abutting contact with the
target shaped periphery of the workpiece;

pressure applying means for applying a pressure force to the lapping film to cause the lapping film to be held in pressured contact with the target shaped periphery of the workpiece;

rotating means for rotating the workpiece about an axial direction during operation of the pressure applying means to allow the surface finish tool to surface finish the target shaped periphery of the workpiece into the mid-concave profile, while exhibiting a distribution pattern of the pressure force of the surface finish tool; and

oscillating means for oscillating at least one of the workpiece and the lapping film in the axial direction of the workpiece in a given oscillation stroke such that a working position of the lapping film is cyclically shifted in the given oscillation stroke with respect to the target shaped periphery of the workpiece to allow the workpiece to be surface finished in the mid-concave profile,

wherein the pressure applying means is adapted to operatively apply pressure on a rear side of the lapping film in different contact areas in a partially overlapping relationship at a central region of the target shaped periphery of the workpiece and in non-overlapping relationship in both terminal regions of the target shaped periphery such that the portions of the pressure applying means disposed on the rear side of the lapping film are held in opposing offset positions with offset displacement of each of the portions of the pressure applying means disposed on the rear side of the lapping film set to be less than the given oscillation stroke provided by the oscillating means to allow the central region of the target shaped periphery to be lapped at a greater rate than those at which other regions of the target shaped periphery are lapped, resulting in the target shaped periphery having a surface profile formed in the mid-concave profile having a depth equal to or greater than 5 μm and equal to or less than 20 μm .

27. A method of surface finishing a target shaped periphery of a workpiece into a mid-concave profile, the method comprising:

supporting the workpiece having the target shaped periphery to be surface finished;

holding a surface finish tool including a lapping film in abutting contact with the target shaped periphery of the workpiece;

disposing a plurality of shoes on a rear side of the lapping film to apply a pressure force to the lapping film to cause the lapping film to be held in pressured contact with the target shaped periphery of the workpiece;

rotating the workpiece about an axial direction to allow the surface finish tool to surface finish the target shaped periphery of the workpiece into the mid-concave profile, while exhibiting a distribution pattern of the pressure force of the surface finish tool; and

oscillating at least one of the workpiece and the lapping film in the axial direction of the workpiece in a given oscillation stroke such that a working position of the lapping film is cyclically shifted in the given oscillation stroke with respect to the target shaped periphery of the workpiece to allow the workpiece to be surface finished in the mid-concave profile,

wherein the plurality of shoes are held on the rear side of the lapping film in different contact areas in a partially overlapping relationship at a central region of the target shaped periphery of the workpiece and in non-overlapping relationship in both terminal regions of the target shaped periphery such that the plurality of shoes are held in opposing offset positions with offset displacement of each of the plurality of shoes set to be less than the given oscillation stroke to allow the central region of the target shaped periphery to be lapped at a greater rate than those at which other regions of the target shaped periphery are lapped, resulting in the target shaped periphery having a surface profile formed in the mid-concave profile having a depth equal to or greater than 5 μm and equal to or less than 20 μm .

EVIDENCE APPENDIX

As evidence, Appellants present JP '090, along with Abstract page. This evidence was entered in the record by the Examiner on August 08, 2006, as evinced by the initialization of Appellants Modified Form PTO/SB/08 attached to the Office Action mailed on that date.

RELATED PROCEEDINGS APPENDIX

There are no related proceedings.

PATENT ABSTRACTS OF JAPAN

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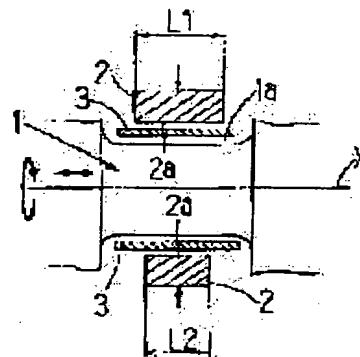
(72)Inventor : HIRAYAMA HIROKI
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(54) PAPER LAPPING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To prevent local excessive shaving, and improve straightness of a finishing surface by asymmetrically arranging contact parts with lapping paper of respective lap shoes to the axis of a work.

SOLUTION: Among a pair of lap shoes 2 arranged on both sides of a work 1, contact parts 2a with lapping paper 3 are asymmetrically arranged to the axis X of the work 1. Even when the work 1 is oscillated in the axial direction, polishing areas by the individual lap shoes 2 do not completely overlap each other, and a part among these becomes an area polished by only either one lapping paper 3. Therefore, a stroke of oscillation in a stroke end part can be weakened, and as a result, local excessive shaving in this part is prevented, and straightness of a finishing surface is improved.



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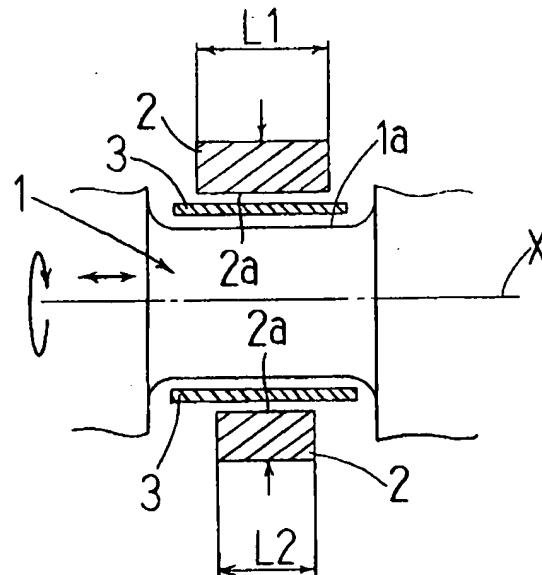
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(54)【発明の名称】 ペーパラッピング装置

(57)【要約】

【課題】 局所的な削りすぎを防止し、仕上げ面の真直度を向上させる。

【解決手段】 軸状ワーク1の両側に配置された一対のラップシュー2のうち、ラッピングペーパ3との接触部2aの軸方向幅(L1)(L2)を異ならせる(L1>L2)。



(2)

特開平10-217090

【特許請求の範囲】

【請求項1】 軸状ワークの外周面の周囲に複数のラップシューを配置し、ワークを回転させながら、各ラップシューでワークの外周面にラッピングペーパを押し付けてワークの外周面を研磨するものにおいて、各ラップシューのラッピングペーパとの接触部をワークの軸線に対して非対称に配置したことを特徴とするペーパラッピング装置。

【請求項2】 各ラップシューのラッピングペーパとの接触部の軸方向幅を異ならせた請求項1記載のペーパラッピング装置。

【請求項3】 各ラップシューのラッピングペーパとの接触部の軸方向幅をそれぞれ等しくし、且つ当該接触部を軸方向にずらせて配置した請求項1記載のペーパラッピング装置。

【発明の詳細な説明】**【0001】**

【発明の属する技術分野】 本発明は、軸状ワークの外周面をラッピングペーパ用いて研磨するためのペーパラッピング装置に関するものである。

【0002】

【従来の技術】 軸状のワーク、例えばエンジン部品の一つであるクランクシャフトのクランクピン部などの仕上げ加工では、ワークの外周部にペーパラッピングによるラップ加工を施す場合がある（特開平5-169361号、特開平7-52005号、特開平7-75953号の各公報参照）。

【0003】 このペーパラッピングは、図3(a) (b)に示すように、テープ状のラッピングペーパ(3)を、ワーク(1)を挟むようにして配置した一対のラップシュー(2)でワーク外周面(1a)に押し付け、この状態でワーク(1)を図示しない駆動装置で回転させることにより行われる。ラッピングペーパ(3)は、上方から一方のラップシュー(2)の下方、両ラップシュー(2)とワーク(1)との間の隙間、および他方のラップシュー(2)の下方を順次通過させて上方に引き回されており、その両端はそれぞれ繰り出しロールと巻き取りロール（何れも図示省略）に接続されている。ラップシュー(2)は、それぞれアーム(5)の下端に取り付けられており、アーム(5)を矢印方向に閉じることによって両ラップシュー(2)がワーク(1)の外周面に押し付けられるようになっている。上述のようにラップ加工中は、ラップシュー(2)によってラッピングペーパ(3)がワーク外周面(1a)に押付けられ、かつワーク(1)が軸線(X)を中心として回転駆動されるのであるが、これと同時にワーク(1)の被研磨面をその全域で均一に研磨できるよう、ワーク(1)は、所定ストロークで軸方向に往復駆動される（オシレーション）。

【0004】 このような装置において、従来では、両ラップシュー(2)を、軸方向の幅(L)を等しくした同

形状とし、かつ互いに対向する位置に配置している。

【0005】

【発明が解決しようとする課題】 従来装置では、図4に示すように、オシレーションのストローク(S)の両端部でラッピングペーパ(3)がワーク(1)表面に強く当たるため、この部分で削りすぎが生じ、ワーク(1)の両端部が望ましい仕上げ面（破線で示す）よりも凹んで真直度が悪化する場合があった（但し、凹み6の深さは誇張して描いている）。

【0006】 そこで本発明は、局所的な削りすぎを防止し、仕上げ面の真直度を向上させることのできるペーパラッピング装置の提供を目的とする。

【0007】

【課題を解決するための手段】 上記目的を達成すべく、本発明にかかるペーパラッピング装置は、軸状ワークの外周面の周囲に複数のラップシューを配置し、ワークを回転させながら、各ラップシューでワークの外周面にラッピングペーパを押し付けてワークの外周面を研磨するものにおいて、各ラップシューのラッピングペーパとの接触部をワークの軸線に対して非対称に配置したものである。

【0008】 具体的には、各ラップシューのラッピングペーパとの接触部の軸方向幅を異なる。

【0009】 また、各ラップシューのラッピングペーパとの接触部の軸方向幅をそれぞれ等しくし、且つ当該接触部を軸方向にずらせて配置する。

【0010】

【発明の実施の形態】 以下、本発明の実施形態を図面に基づいて説明する。なお、本発明装置は、ラップシューを除き、図3(a) (b)に示す従来装置とほぼ同様の構造であるので、以下では共通事項の説明を省略し、相違点を中心に説明する。

【0011】 図1に示すように、本発明装置では、軸状ワーク(1: 例えばクランクシャフトのクランクピン部)の両側に配置された一対のラップシュー(2)のうち、ラッピングペーパ(3)との接触部(2a)が、ワーク(1)の軸線(X)に対して非対称に配置される。図1では非対称的な配置として、2つのラップシュー(2)の接触部(2a)の軸方向幅(L1) (L2)を異なせた場合を例示している(L1>L2)。

【0012】 以上の構成から、ワーク(1)を軸方向にオシレーションさせた場合でも、個々のラップシュー(2)による研磨領域が完全に重なり合うことはなく、そのうちの一部は、何れか一方のラッピングペーパ(3)のみによって研磨される領域となる。従って、オシレーションのストローク端部での当たりを弱くすることができ、その結果、この部分での局所的な削りすぎを防止して仕上げ面の真直度を向上させることが可能となる。

【0013】 なお、接触部(2a)は、軸線(X)に対し

(3)

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て非対称に配置されれば足り、図1に示すように、軸方向幅（L1）（L2）を異ならせたものに限定されない。具体的に、例えば図2に示すように、両接触部（2a）の軸方向幅（L）を等しくし、かつ、その位置を軸方向にずらした場合でも同様の効果が奏される。

【0014】以上の説明では、軸状ワーク（1）の例としてクランクシャフトのクランクピン部を例示したが、本発明の適用範囲はこれに限定されるものではなく、軸状をなすワーク一般に広く適用可能である。ここで「軸状ワーク」とは、外周面の断面が円形であるものをいい、中実状のもののみならず中空状のものも含む意である。

【0015】また、本発明は、ラップшу（2）がワーク（1）の外周面（1a）の周囲の複数箇所に配置されれば適用可能であり、上述のようにラップшу（2）をワーク（1）の両側2個所に配置する場合のみならず、外周面（1a）周囲の3個所以上に配置する場合にも同様に適用可能である。

【0016】

【発明の効果】本発明によれば、軸状ワークをペーパラッピングするに際し、オシレーションのストローク端部での局所的な削りすぎを防止して、仕上げ面の真直度を向上させることが可能となる。

【図面の簡単な説明】
【図1】本発明にかかるペーパラッピング装置の一実施形態を示す軸方向の断面図である。

【図2】本発明にかかるペーパラッピング装置の他の実施形態を示す軸方向の断面図である。

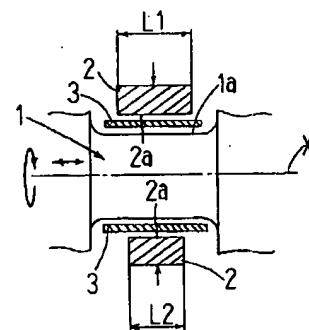
【図3】（a）図は従来装置の軸方向の断面図であり、（b）は半径方向の断面図である。

【図4】従来装置によって加工されたワーク仕上げ面の拡大断面図である。

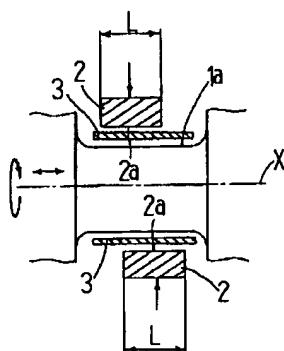
【符号の説明】

- | | |
|----|----------|
| 1 | ワーク |
| 1a | ワーク外周面 |
| 2 | ラップшу |
| 2a | 接触部 |
| 3 | ラッピングペーパ |
| X | 軸線 |

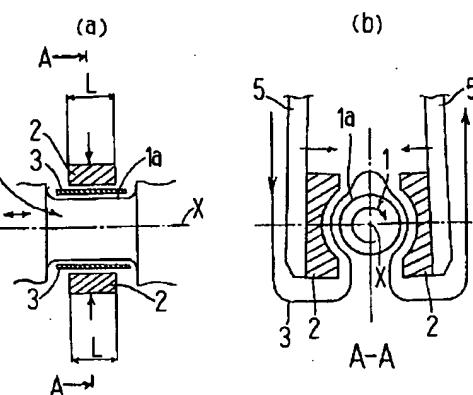
【図1】



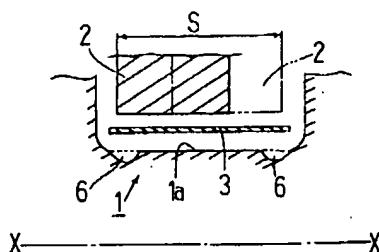
【図2】



【図3】



【図4】



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